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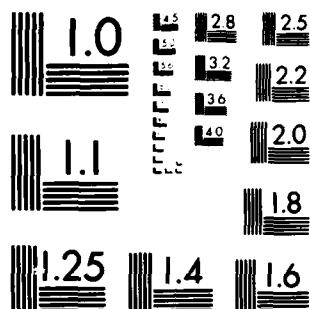
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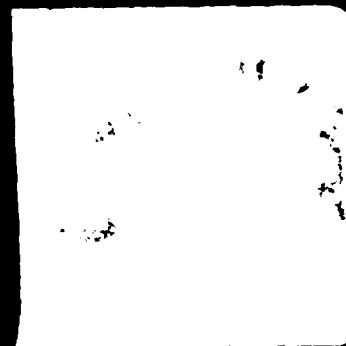
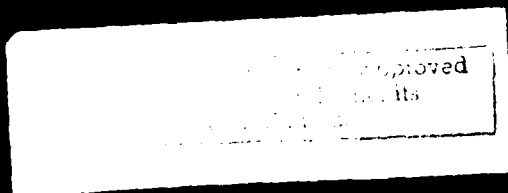
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June 1982

DCIEM Technical Communication No. 82-C-20

MMI CONSIDERATIONS IN THE
TELETYPE GRAPHICS SYSTEM
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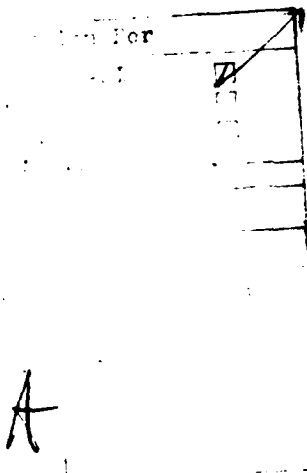
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ABSTRACT

SHAPE Technical Center has developed the Transitional Information Distribution Experiment (TIDE) to study the storage, handling and display of information in SHAPE HQ. This report comments on some human factors aspects of the Teletide Graphics System (Version 2.0), the part of TIDE used to create, manipulate and display information on maps. Relevant portions of DCIEM research plans are briefly described.

GENERAL

The Transitional Information Distribution Experiment (TIDE) is a system developed by SHAPE Technical Center (STC) to study the storage, handling and display of information in the SHAPE HQ. The system design has been derived from a careful analysis of the military user's requirements for information. Its success is due in large part to a philosophy of reasonable, attainable design goals, an iterative approach to design which permits constant feedback from the user, and sensitivity to the user's need for an accessible, easily-learned system. The result is one of the few computer-based information systems actually being used by land forces personnel. It is also the only one using digitized maps for presenting the ground force situation. Its success is attested by the fact that military users requested that it remain in operation beyond the experimental testing periods. The system specifications that will result from TIDE will be implemented as part of Project 85, an upgrading of SHAPE's command and control systems.

Successful as TIDE is, there remain some areas in which it might be improved. The following are comments on the user interface to the Teletide Graphics System, the component of the TIDE system which permits display creation, update and manipulation. They are based on DCIEM's experience with the system over the period 9-13 June, 1981, on the STC working paper entitled "Teletide Graphics System User Manual, Version 2.0" (Ref. 1), and on conversations with STC personnel. Since the documentation on which these comments are based was in draft form, certain misconceptions about system operation may have resulted. These are noted where suspected. These comments assume that the reader is familiar with the TIDE system at least generally and has access to the STC Teletide User Manual.

To assist analysis, a set of flow diagrams was drawn up, reflecting the sequence of the Teletide dialogue as described in the manual. These are presented in Figure 1.

The remarks are divided into four sections:

- 1) - Comments on the human engineering of the interface to the menu system, including inconsistencies which have probably occurred as a result of the lengthy time span of Teletide development;
- 2) - Teletide enhancements that could be included as part of the specifications for Project 85;
- 3) - More general remarks on the interaction technique used and some alternatives that could be considered for future systems;
- 4) - Some human factors issues that will arise in future systems when maps are created and manipulated by the military user.

TELETIDE DIALOGUE

Display pages and overlays

There are inconsistencies in the terminology and labelling used to describe a display "screenful" of information created by the user. In most usages, a "display page" consists of a background map, an overlay of military symbology and a descriptive frame with title, classification, "as of" time and name (e.g., AS01). In such a case, it could also be referred to as a situation display. Alternatively, a display page could consist of a plain colour background with superimposed alphanumeric text plus the descriptive frame. In many instances in the Teletide dialogue, the word "overlay" is used as a synonym for display page, the name of the page being synonymous with the name of the overlay. This causes confusion. For instance, the main directory (described in section 2.1 of the user's manual) is called an "OVERLAY DIRECTORY", but, in fact, lists display pages. Similarly, the DISPLAY command asks for an OVERLAY NAME, but presents display pages on the TV screen. The CREATE command asks for a DISPLAY NAME (entered as @@##), and then refers to the creation of OVERLAY @@##. The REMOVE command may also confuse the user since it is not clear whether he is erasing just the military symbology, or the associated map as well. (A better term might be CLEAR, since the user is not removing the display page, but clearing it for future use.) Similarly when the user ATTACHs or ADDs information to an existing display, is it just the overlay portion that is added, or the entire display (i.e., what happens when the maps are different?).

It is not easy to resolve these discrepancies. Perhaps a clear definition of the terminology (in the user introduction to the system) as well as careful attention to its usage in the dialogue will be sufficient. For example, instead of referring to OVERLAY @@##, the phrase used should be DISPLAY PAGE FOR OVERLAY @@##.

Flow of control

The flow of control within the menu system is unclear at certain points, particularly at the exits within the menu (refer to Figure 1). In many cases these problems may be due to incomplete documentation. The following trouble points were noted:

- 1) - It is not clear where the control goes when the user exits prematurely (by typing XX) from LG or MP in VIEW. Perhaps he should be sent back to the VIEW menu (whether he came in from VIEW or CREATE), which then provides the option of either looking for a

different map, or exiting to the main menu.

- 2) - In VIEW, it is assumed that the LG and LM commands pass into the MP sequence when a particular map number is selected (manual section 3.3.4, and 7.4).
- 3) - In the CREATE sequence, the user is offered the option to type
XX TO EXIT THIS SECTION (manual section 3.1.2),
if he has decided he does not want to proceed with the map previously selected (section 3.1). The XX command does not exit from CREATE, as expected, but instead goes to the VIEW menu. The user dialogue should reflect this by stating instead:
TYPE "VV" TO SEE THE AVAILABLE MAPS.
- 4) - Passage of control when the user exits from the SAVE command under EXIT (within UPDATE) is not clear (section 5.11.2.1); it should be back to the main menu.
- 5) - There is an inconsistency in the wording of the menu options for exiting prematurely from DRAW AIR FORCE SYMBOL, DRAW NAVAL SYMBOL and DRAW GENERAL SYMBOL (sections 5.1.5, 5.1.6 and 5.1.7). The terminology used is
DRAW NOTHING,
whereas the preferred terminology used at other similar points in the dialogue is
EXIT.

Alpha codes

The use of two letter codes for menu items is not the preferred input technique (see below for more comments on this issue). If this technique is used, however, research carried out at the Army Research Institute (Reference 2) indicates that the codes should be derived by simple truncation of the full word being abbreviated (i.e., they should correspond to the first two letters of the word). ARI's experiments showed that the truncation method of abbreviation was consistently preferred, easily decoded and frequently used for encoding terms, compared to abbreviations based on contraction or contraction and truncation. These findings are for abbreviations for single words. For the several instances in the Teletide system where the menu option consists of more than one word, it is recommended that the first letters of the first two words be used as an abbreviation. For the cases where truncation would result in conflicts in the menu options (e.g., DIRECTORY-DI and DISPLAY-DI), it is suggested that the terminology could be changed (SHOW-SH for DISPLAY).

Menu format

The format for menu presentation varies widely. Most of the menu frames are presented with the coded choice to the right of the item (e.g., UPDATE, section 5):

DRAW A SYMBOL	DR
DELETE A SYMBOL	DE
MOVE A SYMBOL	MO
CHANGE A SYMBOL	CH

Most of the menus within a function are presented in the form

= @@@@@@@@@ (e.g., levels of units, section 5.1.4.2).

However, some are presented in a list in the form

@@@@@@ # (e.g., airforce symbol types, section 5.1.5),
or in the form

@@@@@@@@ # (e.g., background maps, section 3.3.4).

The choice of SIZE OF SYMBOL is presented as

SIZE OF SYMBOL (1 = SMALL, 2 = MEDIUM, 3 = LARGE)

with the string of menu items in brackets (e.g., section 5.1.4.3). The menu for OWN/ENEMY is presented in a similar manner with alpha rather than numeric codes.

To reduce visual scanning by the user, the format of menu presentation should be standardized. It is recommended that main menus (ones with two letter @@ input codes) be presented in a list in the form

@@@@@@ @@.

Menus offering a choice of symbol attributes should be presented in a list in the form

@@@@@@ ##

with the number coding starting at 1 (not 0, as is currently the case for the menu for LEVEL OF ARMY UNIT (section 5.1.4.2)).

Similarly there is wide variation in the style in which user input is invited. In some cases the command line inviting user input occurs before the list is presented (e.g., the VIEW menu); in others, it occurs after the list (section 5.1.6, naval symbols). In some instances the user is asked to ENTER, in others to TYPE, and in others to ANSWER. In some cases, the appropriate user input is enclosed in quotes e.g.,

ENTER "ZZ" FOR A LIST (section 12.1)

or

ENTER "VV" TO VIEW ... (section 3);

in other cases, the corresponding codes are simply listed (e.g., section 5.4). It is recommended that the options available at each stage in the dialogue be listed, with a title, followed by the command line requesting user input e.g.,

LEVEL OF UNIT?

Where this is not possible (e.g., when a yes/no response is required), the options should be presented in brackets after the question e.g.,

DO YOU WANT RIVERS? (YES OR NO).

The list of options can be omitted in order to speed up the dialogue for more sophisticated users.

Order of attribute input

The order of attribute input for symbol DRAWing (sections 5.1.4 to 5.1.7) should be standardized as much as possible. The following order is recommended: TYPE (input first since it is one of the most important attributes, and should not be retained in short term memory longer than necessary); OWN/ENEMY; either EQUIVALENT STRENGTH (for sections 5.1.4.1 and 5.1.4.3), or NATIONALITY, NUMERIC DESIGNATION, LEVEL (for section 5.1.4.2); and finally SYMBOL SIZE, followed by the cursor positioning commands.

Cursor commands

The technique for cursor movement is not immediately clear to a new user. The following dialogue is recommended:

MOVE CURSOR TO THE DESIRED POSITION ON THE SCREEN,
THEN ENTER A CURSOR COMMAND:
S = THIS IS THE POSITION I WANT
X = CANCEL THIS OPERATION

COMMAND?

For more experienced users, this dialogue could be shortened to
POSITION?

OWN/ENEMY vs COLOUR

In some cases the user is asked for the ownership of the unit which he is drawing e.g.,

OWN/ENEMY (section 5.1.4.1 to 5.1.4.3);
in other cases, the same question is posed in terms of the COLOUR (white, blue or red) to be used to code the symbol (e.g., section 5.1.5 to 5.1.7). Colour is being used here to code information of operational importance, and the user dialogue should refer to the information, not the coding technique. The information should be requested by the phrase

OWN/ENEMY?

In cases where colour is not used as a code (e.g., where text is being entered (sections 5.1.1 and 5.1.3)), the term COLOUR should be used in the dialogue.

Symbol size

In contrast to the above cases, the size of the symbol drawn has no operational significance. To avoid user confusion between SIZE and some other unit attribute, (like STRENGTH), specific reference should be made to SYMBOL SIZE in all cases where the size of the symbol can be chosen by the user (e.g., most functions in DRAW, section 5.1.1 to 5.1.7).

CAPITALS vs CITIES

In the CREATE and VIEW dialogues, the user is asked whether he wants CAPITALS (cities) included on the map. In the EXIT dialogue, the term CITIES is used. The latter term is preferable.

STANDARD ARMY SYMBOL

One menu option presented in section 5.1.4 is
DRAW STANDARD ARMY SYMBOL.
The word ARMY may be confusing to some users, since it does not refer to the level of the unit, as do the other choices in the menu (e.g., DRAW BRIGADE EQUIVALENT SYMBOL). A better phrase might be
DRAW STANDARD UNIT SYMBOL.

VIEW function

The VIEW function (section 7) is difficult to understand, partly because of the wording used in the menu and for the display titles. A more compact presentation may be desirable.

- 1) - Combine the LG and LM functions into a single function (called LM) similar to the DIRECTORY function. The user would have the option of typing LM (to get the region list), LM @@ (to get maps of region @@) or LM ZZ (to get all maps).
- 2) - Combine the DG, RD and MP functions into one DISPLAY MAP (DM) function. The user would have the option of typing DM ## to get a particular map, DM @@ (to see the geographical regions), or DM. In the latter case, the user would then be presented with the display of geographic regions, and asked to choose one for further display. Upon input of @@, the maps of the appropriate region would be displayed, and the user would be asked which map he wanted to see. See Figure 2 for a flowchart describing this function and the previous one.
- 3) - Change the titles of the display (described in sections 7.1 and 7.3) to reflect the information being presented to the user. In section 7.1, the user is viewing GEOGRAPHIC REGIONS. In 7.3, he is viewing MAPS IN GEOGRAPHIC REGION @@.

ERASE/RECALL

The ERASE command (under UPDATE) can only be invoked after ADD or ATTACH. Similarly, the RECALL command is valid only after DELETE. To avoid mistaken usage of these commands, they should appear in the UPDATE menu only when their use is valid, not all the time.

EQUIVALENT STRENGTH

The phrase DIV/BGE EQV STRENGTH is used in both dialogues for DRAW DIVISION EQUIVALENT (section 5.1.4.1) and for DRAW BRIGADE EQUIVALENT (section 5.1.4.3). The wording should be changed to reflect the symbol being drawn in each separate case.

AS OF TIME

It is not clear what the user must type to input the AS OF TIME (sections 3.4 and 5.11.2). The example given shows a date-time group of the form 2045 09 NOV 79, whereas the manual dictates a date-time group including hyphens and dashes.

Abbreviations in Prompts

The use of abbreviations should be restricted to those that are well-known to the user. It is recommended that EQV (used in section 5.1.4.1) and EQUIV (section 5.1.4.3) be expanded to the full word EQUIVALENT. Similarly BG in the main menu should be expanded to BACKGROUND.

Feedback

It is desirable to have more feedback about the status of overlays and updates, particularly when the user has cancelled or exited prematurely from a function. Such feedback helps to build user confidence in the system. Teletide designers mentioned that it might be helpful to the user to have an indication of the menu level at each stage of interaction e.g.,

UU/DR/UB (the user is drawing unit boundaries under UPDATE).
We concur, and feel that such a feature will help reduce the impression that users of large menu systems often have of being "lost in the maze".

ENHANCEMENTS

Levels of Dialogue

One of the problems in man-computer interaction is to provide an interface that accommodates the training and experience of a variety of users. New users of a system are often intimidated by the succinct requests (and error messages) which are presented by the computer, whereas more experienced users often feel their interaction is being hampered by verbose dialogues, feedback and examples at every stage. One solution to this problem is to provide different levels of dialogue for users of different sophistication. The designers of the Teletide system have already incorporated this suggestion to a degree by providing direct and indirect commands at the main menu level, and by allowing several menu selections to be input in a single command string. However, it is recommended that this feature be extended by providing three levels of dialogue for the user, and permitting him to choose the level he prefers.

Level 1, designed for new users, would provide a verbose interface, which guides the user step-by-step by providing instruction and lots of examples. Pages of text introducing the system to the user would reside at this level. There should be extensive feedback at each step to indicate where the user sits in the menu system. This level should, in fact, act as an on-line tutorial and review of system use.

Level 2 would be the working dialogue for the majority of users. It would essentially be the same as the dialogue described in the current system manual. Users should be able to get more help at any point in the dialogue by typing HELP for instructions, or EG for an example of the appropriate input at that stage.

Level 3 is for frequent system users who will accept a very sparse dialogue to speed up the interaction. For such users, the menu lists may be omitted and the information requested in a short phrase e.g.,

SIZE OF SYMBOL?

This level of user should be permitted to see the appropriate menu at any stage in the dialogue if he hits RETURN without a menu selection. Appendix A presents sample dialogues for the three levels for the dialogue of section 5.1.4.1.

Tutorial

In addition to the inclusion of a tutorial level of user dialogue in the Teletide system, it is recommended that a separate tutorial package be provided for the new user. The package should include a set of pre-generated display pages and a series of sample problems designed to familiarize him with all parts of the system. This will not only provide an environment for directed learning, but will allow the user to experiment with the commands offered in the Teletide system without fear of compromising the information in the display pages used for normal SHAPE HQ operations.

Text Editors

It would be preferable if the two text editors in Teletide (one in the DRAW function and one in UPDATE) could be combined into one, but remain available under both functions in the system. This would eliminate the current problem of being able to modify text using only the editor in which it was created.

DCIEM found the new text editor rather difficult to use, partly because the the two letter codes for editing commands are prefaced with the escape character. The editing sequence is slow because the user is continually looking from screen to screen for feedback as he types in the command string and then checks to ensure that it has had the effect he wanted. The fact that the keyboard is used both as a device for typing text onto the screen, and as a device for manipulating that text means that there is not a clear separation of these functions for the user. An alternative to the typed editing commands is to provide function keys which insert and delete lines and characters. A good example of these function buttons is found on the Hewlett-Packard 2645 graphics terminal. The keys operate as follows:

Insert line - A blank line is inserted above the line currently pointed to by the cursor and the cursor is sent to the beginning of the new line.

Delete line - The current line is deleted and the cursor is sent to the beginning of the following line.

Insert character - All characters typed after this button is pushed will be inserted ahead of the current cursor position. A small light tells the user that he is in this mode. To get out of the insert character mode, the user depresses the button again, and the light goes out. Characters typed on the screen will then replace those already there.

Delete character - The character indicated by the cursor is deleted and the remaining text is moved left to fill the gap.

The functions for inserting and deleting lines and deleting characters will repeat as long as the appropriate button is depressed. Such a mode of interaction could be implemented by software on a graphics terminal with a conventional keyboard.

INTERACTION TECHNIQUE

Man-computer interfaces should permit interaction that is fluid and easy, and that take place as fast as the user desires. The typed input technique used in the Teletide system is slow, even for a new user. Interaction through a keyboard is particularly cumbersome when the user wishes to place symbols on a map, or update the symbols, especially if the information is being dictated verbally. A two-letter input code is required by the system to reduce errors in menu item selection. However, some of the codes employ two identical letters. This should be avoided; if the first letter was an error, the requirement to simply repeat it gives no opportunity for second thought. In any case, other input techniques could be used to minimize menu selection errors. For example, provision should be made for the user to change his mind about an input if he realizes a mistake has been made, by allowing him to back up in the input sequence to correct his error.

Probably the fastest interface for systems such as Teletide is one which is voice-driven. Voice-driven input is probably more accurate than typed input, although suitable feedback must be provided to the user. This can be done visually, or by voice synthesis. Automatic speech recognition is a field that is being intensively investigated, and many systems are in use world-wide. Prices for useful systems range from \$2,500 for an Interstate system with 3% error in recognition (based on a 20 word vocabulary) to \$65,000 for a Verbex system with 0.2% error in recognition. These error rates were obtained in controlled laboratory conditions, but comparable rates should be attained by trained and motivated operators in the field. DCIEM is interested in doing studies of man-computer interaction using voice-driven menu systems, although at present it has no suitable equipment.

An alternative would be a cursor-driven menu system, where instead of typing an alpha or numeric code for menu items, the user selects it using a cursor driven by a rollball or tablet. Use of a keyboard is necessary only when a label such as a display page title or date-time group must be entered. We speculate that such an interface would be faster than the current typed interaction, at least for non-expert users. DCIEM intends to investigate the issue further by carrying out a small experiment to compare menu selection using typed codes vs cursor-driven item selection. We will use the menus of the Teletide system as the stimulus material and include menu familiarity and learning as factors by investigating performance over several experimental sessions.

MAP MANIPULATION

One unique feature of the Teletide system is the provision of a set of simple computer-generated maps which have been derived from the World Data Bank cartographic data set. Generally these maps are satisfactory for most of the fairly static situation displays used in briefings, but the military user has expressed an interest in being able to generate maps in real time for any segment of the world, at a range of scales. He will therefore need to interact more directly with the cartographic data base, and will eventually need the facility to scroll the map display and zoom in on certain regions. Investigations of zooming and scrolling are currently being carried out as part of DCIEM's experimental program in computer-based map interaction.

The present Teletide system does not provide any link between the background map and the overlaid military information. In other words, the user cannot ask the system to give distances between military units and cities or to do more sophisticated problem-solving such as planning a route for equipment movement in a logistics operation. Before this capability and the capability to generate maps "on the fly" can be provided, suitable ways must be found to structure the cartographic data to allow fast access and manipulation of it. Such techniques are now being investigated in a DCIEM contract for design of an Interactive Spatial Information System (ISIS).

Another issue is the question of how much map information is required for the user to orient himself on a particular map. Teletide system designers have guessed that river and major cities, at minimum, are required but expressed concern that there were no research findings to guide them on this issue. The problem becomes more complicated if the military operation is in a remote part of the world where there are few, if any, instances of the default map features (e.g., the Sahara desert). This is a problem that will receive research attention at DCIEM. The ISIS system is intended to permit the display of situationally relevant features at appropriate scales.

REFERENCES

1. Teletide graphics system, User manual, Version 2.0, DRAFT WORKING PAPER, September, 1980.
2. Moses, F.L., L.M. Potash, Assessment of abbreviation methods for automated tactical systems, Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, ARI-TR-398, AD-a077 840, August, 1979.

FLOW CHA

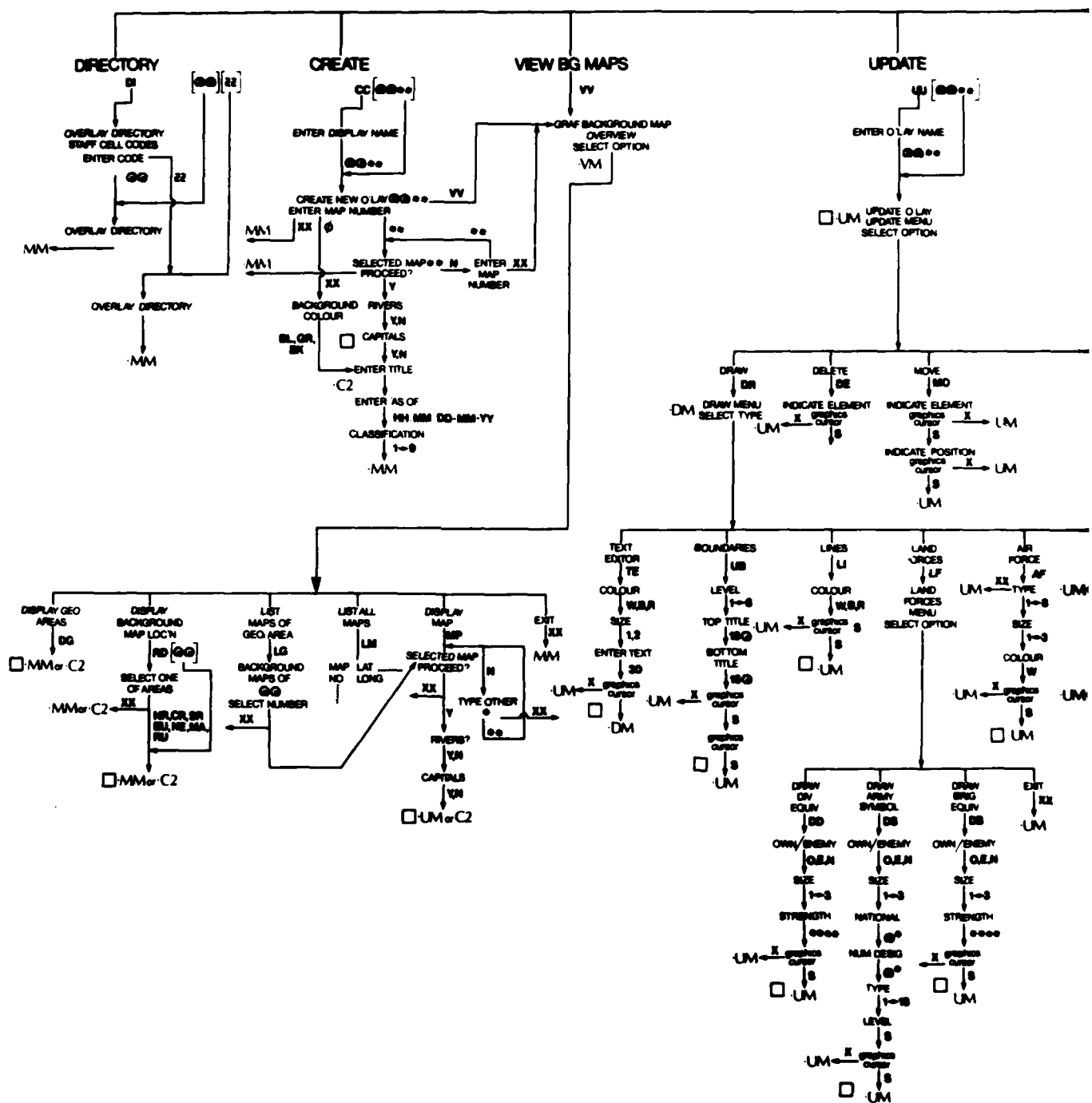
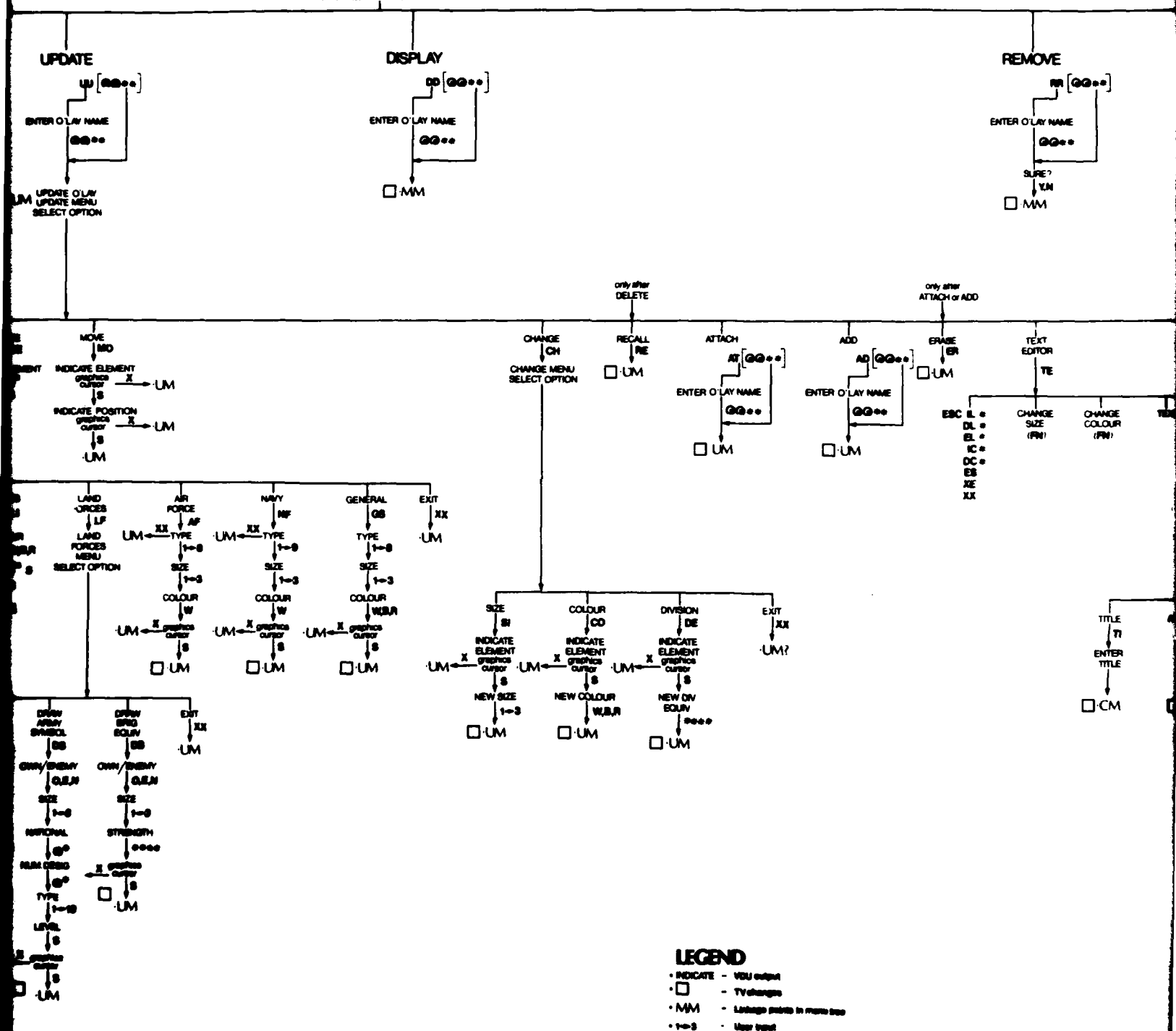
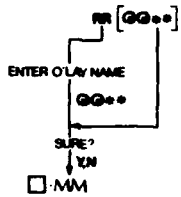


FIG 1
FLOW CHART FOR TELETIDE MENU SYSTEM
MAIN MENU MM



REMOVE

TERMINATE



XX

MM

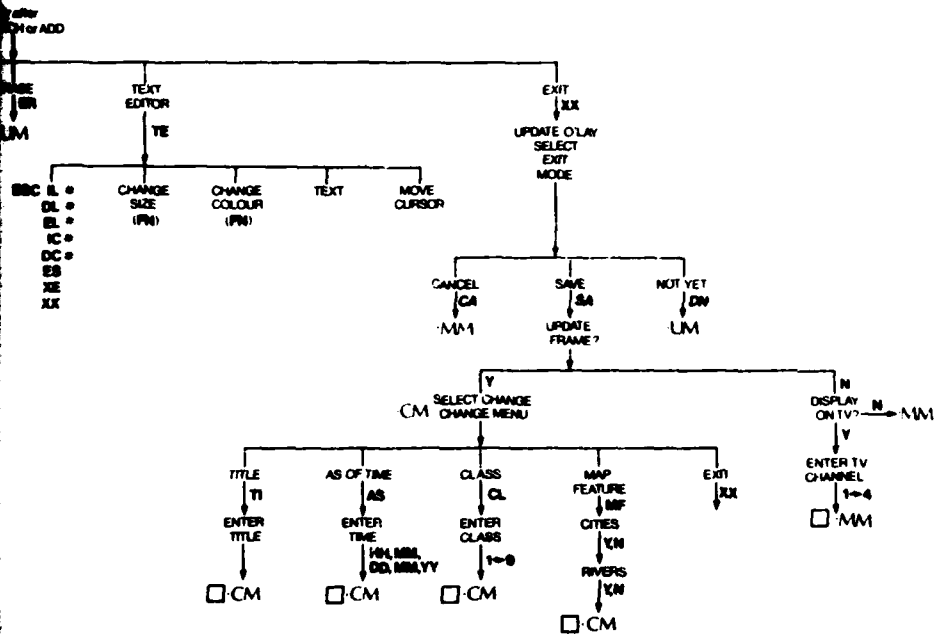
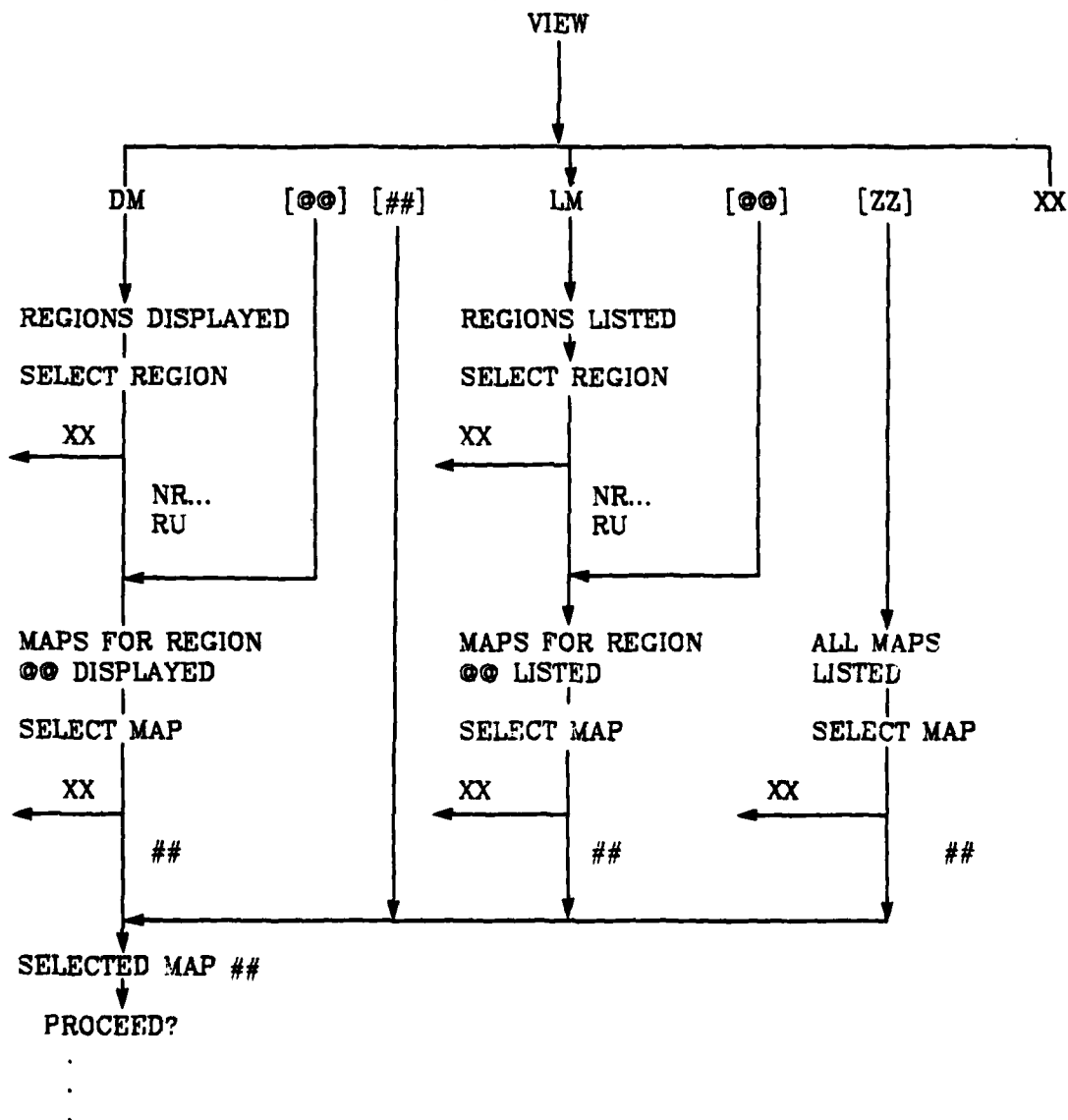


FIGURE 2
FLOW DIAGRAM FOR SUGGESTED VIEW FUNCTION



APPENDIX A

SUGGESTED DIALOGUE FOR THREE LEVELS OF USER (UPDATE/DRAW/LAND FORCES/DIVISION EQUIVALENT, section 5.1.4.1)

LEVEL 1:	LEVEL 2:	LEVEL 3:
YOU HAVE CHOSEN TO DRAW A DIVISION EQUIVALENT SYMBOL.	OWNER OF UNIT: OWN 1 ENEMY 2 NEUTRAL .. 3	OWNER? 1
THESE ARE THE CODES FOR OWNER OF UNIT: OWN 1 ENEMY 2 NEUTRAL .. 3	ENTER OWNER: 1	DIVISION EQUIVALENT STRENGTH? 4
CHOOSE THE APPRO- PRIATE CODE AND ENTER OWNER: 1	ENTER DIVISION EQUIVALENT STRENGTH: 4	SIZE OF SYMBOL? 1
DIVISION EQUIVALENT STRENGTH IS INPUT AS A STRING OF NUMERALS E.G., 12 2/3. THE MAXIMUM LENGTH IS [-----].	SIZE OF SYMBOL: SMALL 1 MEDIUM ... 2 LARGE 3	POSITION? S
ENTER DIVISION EQUIVALENT STRENGTH: [-----] 4	ENTER SIZE: 1	
THESE ARE THE CODES FOR THE SIZE OF SYMBOL: SMALL 1 MEDIUM ... 2 LARGE 3	INDICATE POSITION. CURSOR COMMANDS ARE: S= THIS IS THE POSITION I WANT X= CANCEL THIS OPERATION	
CHOOSE THE APPRO- PRIATE CODE AND ENTER SIZE: 1	ENTER COMMAND: S	
INDICATE THE POSITION OF THE SYMBOL ON THE		

DISPLAY SCREEN.
USE THE FUNCTION BUTTONS
TO MOVE THE CURSOR TO THE
DESIRED POSITION ON THE
SCREEN, THEN ENTER A
CURSOR COMMAND:
S= THIS IS THE POSITION I WANT
X= CANCEL THIS OPERATION

ENTER COMMAND: S

**LATE
LME**